ENHANCED TRANSMISSION QUALITY IN PUSH-TO-TALK SYSTEM

TECHNICAL FIELD OF THE INVENTION

The present invention relates to methods and arrangements to enhance transmission quality in a Push-to-Talk system that comprises a sending mobile subscriber and a receiving mobile subscriber whereby a stream of sequences is sent from the sending to the receiving mobile subscriber.

DESCRIPTION OF RELATED ART

In Push-to-Talk over Cellular PoC, cellular radio access networks and mobiles are used in a walkie-talkie-like fashion. It facilitates e.g. one-to-one and one-to-many communication, where one user (in a group) can talk at a time.

The delay requirements on the PoC service is somewhere between "Conversational" (time-critical) and streaming/background (not (as) time-critical). Typically, an end user would expect a response to his talk burst in a few seconds after it has been sent. Requirements include e.g. that voice delay from a sender to a receiver should be no more than 1.6 seconds during a session.

Current radio access resource allocation schemes are typically allocating radio resources for a user based on some estimate of e.g. the link bit-rate demand. This means that there may be a certain degree of "inertia" before the radio access bearer resources are allocated and the data can be transmitted. This is true e.g. for Wideband Code Division Multiple Access WCDMA, where a dedicated channel DCH is typically allocated for each user. This inertia adds to the delay of the talk burst. Note also that the data accumulated

in radio bearer buffers may result in severe burst of data once the DCH channel is allocated. This data has to be handled by a play-out buffer - once it arrives to the receiver. Radio Access bearer towards the Packet Switched domain are typically realized using Acknowledged Mode to achieve resource efficient transmission and bit-exact delivery of the data. The drawback of the acknowledge mode is the fact that it introduces delay jittering, as erroneous data have to be re-transmitted over the air. To summarise, guaranteeing a good play-out quality comes at the expense of additional delay.

SUMMARY OF THE INVENTION

The present invention solves problems related to guaranteeing a good play-out quality of a stream of sequences without the expense of excessive delay. More specific:

- A low voice delay from sender to receiver would call for a *short initial buffering period* before play-out is commenced. However, a too short initial buffering period may result in that the buffer is drained due to the jittering introduced by the radio access realization. A drained play out buffer leads to play-out interruptions and reduced subjective quality.
- A *long initial buffering period* can guarantee good play-out quality. However, the cost comes as an increased delay. The conversational pattern in PoC may then suffer.

The problems are solved by the invention by using a reasonable short buffering period for the incoming stream of sequences before play-out is commenced, and by collecting in parallel the incoming stream into a buffer

having a size that guarantees an improved play-out quality. The collected stream can be re-played at request with high play-out quality.

More in detail the problems are solved by the invention by a method comprising a sending mobile unit, and a receiving mobile unit used by a receiving subscriber. The receiving unit comprises a Play-Out-Buffer and a Repeat Buffer. A stream of sequences is sent from the sending mobile unit to the receiving mobile unit. The method comprises the following further steps:

- The incoming stream of sequences is collected into the Repeat Buffer and into the Play-Out-Buffer. The Play-Out-Buffer has a storage size and a point for commencing play-out that provides low voice delay while the Repeat Buffer has a storage size that provides high sound quality.

- The incoming stream is played-out from the Play-Out-Buffer to the receiving subscriber.

- Replay is commenced of a defined part of the sequences collected in the Repeat Buffer (RB).

An advantage with the invention is that low voice delay is possible.

Another advantage is that "perfect" quality can be achieved on request.

Yet another advantage is that unnecessary "I beg your pardon" transactions can be avoided, as the receiving user can repeat the last burst(s) locally.

Yet another advantage is that off-line play-out of an earlier conversation sequence can be achieved.

The invention will now be described more in detail with the aid of preferred embodiments in connection with the enclosed drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a block schematic illustration of a Push-to-Talk system involving a group of subscribers.

Figure 2 shows a block schematic illustration of two mobile units in a Push-to-Talk system.

Figure 3 shows a flowchart illustrating a method to enhance transmission quality in a Push-To-Talk system.

Figure 4 shows a block schematic illustration of three mobile units in a Push-to-Talk system.

Figure 5 shows co-operation between an Operating Unit and a Replay Buffer more in detail.

DETAILED DESCRIPTION OF EMBODIMENTS

Figure 1 discloses a Push-to-Talk over Cellular system PoC that involves three subscribers A, B, C. Each subscriber A, B and C uses a mobile unit. Mobile unit MB1 is used by A, MB2 by B and MB3 by C. In this example the cellular system is a Wideband Code Division Multiple Access WCDMA system. A Radio Network Controller RNC in the WCDMA system handles the control of base stations NODEB1, NODEB2 and NODEB3. MB1 is located within NODEB1´s cell area, MB2 within NODEB2´s cell area and MB3 within NODEB3´s cell area. Bursts A1-A3 and B1-B2 are sent alternately between MB1 and MB2 via the base stations NODEB1 and NODEB2. The bursts comprise sequences 15-19(=A1), 25-29(=A2), 35-39(=A3) and 20-24(=B1), 30-34(=B1). A1-A3 is sent from MB1 to MB2, and B1-B2 is sent

from MB2 to MB1. The alternately transmission A1/B1/A2/B2/A3 follows walkie-talkie praxis, i.e. only one speaker at a time. The bursts in this example are speech bursts. Each burst comprises five sequences i.e. packages within the burst.

Figure 2 discloses the mobile units MB1 and MB2 that already have been shown in figure 1. The mobile unit MB1 comprises a microphone MIC. The microphone receives speech from subscriber A. The Bursts are composed out of received speech sequences in a radio bearer buffer RBB in MB1 and sent from a sending unit SU in MB1 to a receiving unit RU in the mobile station MB2. The mobile unit MB2 has in figure 2 already received the bursts A1-A3 that have been seen in figure 1.

The mobile unit MB2 comprises a Play-Out Buffer POB that is of type First-In-First-Out. The incoming sequences are received to the receiving unit RU in the mobile unit MB2. The sequences 35-39 are stored in the Play-Out Buffer POB and in parallel the same sequences 35-39 are stored in a Repeat Buffer RB. The Repeat Buffer RB, which also is of type First-In-First-Out has a size that is large compared to the size of the Play-Out-Buffer POB. The Repeat Buffer RB hereby provides high sound quality due to its large size while the Play-Out-Buffer POB provides low voice delay due to its small size, i.e. due to a short initial buffering period before play-out is commenced. As can be seen in figure 2, the sequences 15-29 have already been stored in the Repeat Buffer before storage of the last sequences 35-39. In this example, the number of memory positions in POB is fifteen while the number of memory positions in RB is five. A Play-out Pointer PP in POB points at a sequence 39 which is the sequence that at the moment is being played-out from a loudspeaker LS to the B-subscriber. A Start Repeat Pointer SRP in the Repeat Buffer RB points at a start position of a requested repeat session. Another pointer, a

so called End Repeat Pointer ERP points at a location in the repeat buffer where a repeat session is requested to end. This will be further explained later in the description when a method according to the invention is described.

The mobile unit MB2 comprises an Operation Unit OU that comprises a DISPLAY and a KEYPAD. The Operation Unit is connected to the Play-Out-Buffer POB and to the Repeat Buffer RB. The user of the unit MB2, i.e. the B-subscriber, can influence the Operation Unit. When a specified button on the KEYPAD is pressed, the End Repeat Pointer ERP will move to a memory location in the repeat buffer RB that corresponds to a sequence that at the moment is being played-out and listened to by the subscriber.

A method according to a first embodiment of the invention will now be explained. The description of the method is to be read together with the earlier described figures 1 and 2. The method presumes that a conversation between the A-subscriber and the B-subscriber has taken place according to current Push-to-Talk practice. The sequences 15-19,25-29,35-39 are stored in parallel in the repeat buffer RB and in the Play-Out-Buffer POB. Due to the shorter length of POB compared to RB, only the sequences 35-39 can be seen in POB in figure 2. The method comprises the following further steps:

- The A-subscriber ends his conversation. The A-subscriber hereby indicates to the listening subscribers B that he has finished his part of the conversation.

- The sequence 39 from the A-subscriber is played out from the loudspeaker LS and listened to by the B-subscriber.

- The B-subscriber is displeased with the quality of the sound when listening to sequence 39.

- The B-subscriber presses a defined button on the KEYPAD during listening to the sequence 39. This sequence is from now on called a selected sequence 39.

- The Operating Unit OU fetches an identification mark of the selected sequence 39 from the Play-out-Buffer POB.

- The Operating Unit OU sends a request to the Repeat Buffer RB to set the End Repeat Pointer ERP at the corresponding sequence 39 stored in the Repeat Buffer.

- The Start Repeat Pointer SRP is set by the Operating Unit OU a predefined time t backwards from the End Repeat Pointer ERP. In this example the Start Repeat Pointer is set at sequence 36, the so-called start sequence 36. Either the B-subscriber or the operator of the PoC system has defined the time t in advance in this example. As an alternative, a number of sequences backwards from the selected data stream sequence 39 have been predefined instead of a time.

- Replay is started from the start sequence 36.

- The replay is continued and finally ends when the selected sequence 39 that is pointed out by the End Replay Pointer has been replayed.

As a variation of the above example, instead of the B-subscriber initiates the replay, the replay can take place automatically. Assume buffer under-run, i.e. that the Play-Out Buffer POB drains out due to for example "jitter" or "glitches" and that the play-out quality decreases. When decreased play-out quality is detected by the system (for example by the Operating Unit OU), the system will automatically request replay. Replay will then take place in

accordance with the earlier described model. The difference in short, instead of the B-subscriber detects decreased quality and requests replay, the system automatically detects and requests.

Note that the illustration in figure 2 with two separate buffers for play-out and repetition is made to achieve clarity in the descriptions of the preferred embodiments. In practice, the two buffers POC and RB would preferably be implemented in the same memory storage without any multiple copies of the received sequences, by defining pointers related both to POB and to RB on the same stored sequences of data. Thus, POB would define a buffer that is a subset of the larger buffer RB. This can easily be achieved by using the Play-out Pointer PP (seen in figure 2 within POB) in the Repeat Buffer RB and by defining a pre-buffering level in RB with a size corresponding to the size of POB in figure 2. This means that the sequences 15-19,25-29,35-39 are stored like before in the repeat buffer RB and in the Play-Out-Buffer POB - but not in parallel, since POB is a subset of RB.

In figure 3 some of the most essential steps of the described method are shown in a flow chart. The flow chart is to be read together with the earlier shown figures. The steps are:

- The incoming sequences 15-19,25-29,35-39 are stored in the Play-Out-Buffer and the Repeat buffer RB. A block 101 discloses this step in figure 3.

- The sequence 39 is played out from the loudspeaker LS and listened to by the B-subscriber. A block 102 discloses this step in figure 3.

- Replay is requested either automatically or by the B-subscriber. The replay is requested to end with the selected sequence 39. A block 103 discloses this step in figure 3. The End Repeat Pointer ERP is hereby set at the selected sequence 39 stored in the Repeat Buffer RB and the Start Repeat Pointer SRP is set at sequence 36 in the Repeat Buffer RB.

- Replay is started from the sequence 36 pointed out by SRP, and the replay ends when the selected sequence 39 that is pointed out by the End Replay Pointer has been replayed. A block 104 discloses this step in figure 3.

A second embodiment is shown in figure 4. Figure 4 discloses the mobile units MB1, MB2 and MB3 already shown in figure 1. The mobile units MB1 and MB2 have already been explained when figure 2 was discussed. The mobile unit MB3 has in this embodiment the same function as MB1 in figure 2 and will not be further explained in detail. Note however that MB1 in this second embodiment is a receiver instead of a sender of sequences. The subscriber C handles the mobile unit MB3. This embodiment is a continuation of the first embodiment. After the A-subscriber has finished his conversation, the C-subscriber replies to the A-subscriber by sending sequences 40-48 to involved subscribers, i.e. to the A-subscriber and the B-subscriber. As can be seen in figure 4, the sequences 29,35-48 now has been stored in the Repeat Buffer RB while the sequences 44-48 are stored in the Play-Out-Buffer POB. The problem that will be solved in this embodiment is that while the B-subscriber is listening to sequences 36-39 in the repeat session, as was discussed in the first embodiment, sequences 40-48 are coming in from the C-subscriber and sequences 40-48 cannot be played out during the play-out of sequences 36-39. The solution to this problem is to enhance the replay time by moving the End-

Replay-Pointer ERP from the earlier selected end sequence 39 to a new selected end sequence 48 i.e. to the last sequence received as long as replay goes on. The Operating Unit OU automatically handles the movement of the End-Replay-Pointer ERP. This movement of the pointer takes place as long as new incoming sequences are detected during reply.

Figure 5 discloses a variation of the above second embodiment. Figure 5 shows the Operating Unit OU with the DISPLAY and KEYPAD more in detail. The operating unit is connected in a two-way connection to the Repeat Buffer RB. The burst A2 that comprises the sequence 29 is stored first in the Repeat Buffer (i.e. the FIFO register). A3 with sequences 35-39 comes thereafter, then C1 with the sequences 40-43 and at last C2 with the sequences 44-48. The stored bursts A2,A3,C1,C2 can be seen by the subscriber B in the display. According to this variation of the second embodiment the user is able to select bursts to be replayed by using the KEYPAD. By using the KEYPAD, the user can place arrows START1, END1, START2 and END2 at locations in the display. By placing START1 before A2, END1 after A2, START2 before C1 and END2 after C2, a first start pointer S1 is placed before sequence 29 in the Repeat Buffer. A first end pointer E1 is placed after sequence 29. A second start pointer S2 is placed before sequence 40 and a second end pointer E2 is placed after sequence 48. When the B-subscriber then requests replay, A2 will be replayed. A3 will be "jumped over" while C1 and C2 will be replayed.

Different variations are possible within the scope of the invention. The cellular system can for example be of another type than WCDMA, for example GSM, GPRS or EDGE. The invention is in other words not limited to the above described and in the drawings shown embodiments but can be modified within the scope of the enclosed claims.